

AMENDMENT UNDER 37 C.F.R. §1.111
U.S. Application No. 09/921,683
Attorney Docket No. Q65741

REMARKS

Claims 1-21 are pending in the current application.

Applicant thanks the Examiner for accepting the drawings filed on July 10, 2002.

Applicant amends independent claims 1 and 17 to more clearly recite the features of Applicant's invention as claimed. Applicant cancels claim 7 without prejudice or disclaimer. Applicant adds claims 22-26 to provide an alternate scope of coverage for Applicant's invention in the claims.

The Examiner rejects claims 1-21 under 35 U.S.C. § 103(a) as being unpatentable over European Patent 0947325 A1 to Chang et al. in view of European Patent 0988974 A2 to Chang et al. Applicant respectfully traverses these rejections.

The combination of Chang '325 and Chang '974 do not teach or suggest all of the features of amended independent claim 1. For example, one of the features of Applicant's invention as claimed in claim 1 is "the contracted state holding element is supplied for a time period which is not greater than one quarter the natural vibration period of the pressure chamber". Chang '325 does not disclose or suggest this feature. Assuming *arguendo* that the hold element e corresponds to the contracted state holding element of the claim, Chang '325 discloses that hold element e is extremely short or approximately zero (Chang '325, column 15, lines 47-48). Chang '325 further discloses that the length of hold element e is preferably zero (Chang '325, column 13, line 50-56). Chang '325 does not disclose or suggest that hold element e is supplied for a time period related to the natural vibration period T_c .

Chang '974 does not supply this deficiency in Chang '325 with respect to claim 1. Chang '974 discloses that the duration of waveform element b is not greater than $T_c/2$ (Chang '325, column 12, lines 16-18). If, assuming *arguendo*, that the waveform element g5 corresponds to the contracted state holding element of the claim, it is clear that the duration of waveform element g5 is greater than $T_c/4$. Therefore, Chang '974 does not disclose or suggest "the contracted state holding element is supplied for a time period which is not greater than one quarter the natural vibration period of the pressure chamber" as required by claim 1.

The combination of Chang '325 and Chang '974 also does not teach or suggest all of the features of amended independent claim 17. For example, one of the features of Applicant's invention as claimed in claim 17 is "the contracted amount of the pressure chamber in the second contracting step is not larger than an expanded amount of the pressure chamber in the first expanding step". Chang '325 and Chang '974 do not teach or suggest these features of the claim.

In particular, Figure 13 of Chang '325 shows that the potential difference of element h3, which the Examiner alleges corresponds to the second contracting element of the claim, is clearly larger than element b1, which corresponds to the first expanding element of the claim. Because the potential difference of element h3 is greater than that of element b1, Chang '325 does not disclose that "the contracted amount of the pressure chamber in the second contracting step is not larger than an expanded amount of the pressure chamber in the first expanding step" as required by claim 17.

Furthermore, Chang '974 does not supply these deficiencies in Chang '325 with respect to claim 17. In particular, element b5 does not correspond to the first expanding element as alleged by the Examiner. Chang '974 describes b5 as a preparatory process (Chang '974, column 15, lines 51-52). Furthermore, Chang '974 states that its first expansion process is h5. If, assuming *arguendo*, that j5 of Figure 10 corresponds to the second contracting step, the amount of contraction in j5 is clearly larger than the amount of expansion in h5. Therefore, Chang '974 does not teach or suggest "the contracted amount of the pressure chamber in the second contracting step is not larger than an expanded amount of the pressure chamber in the first expanding step" as required by claim 17.

Furthermore, assuming *arguendo* that the combination of Chang '325 and Chang '974 did teach all of the features of the claims, it would not have been obvious to combine the references as the Examiner suggests, because doing so would render the devices and methods disclosed in these references inoperative. The inkjet printing process of these disclosures relies on careful timing and control of the amount of the expansion and contraction of the pressure-generating chamber. One cannot combine an expansion element or step from one embodiment with the contraction process of another because the expansion and contraction process are interdependent; changing one portion of the process would require changing all of the other expansion and contraction portions accordingly. Therefore, haphazardly combining an expansion portion from one embodiment, for example, with the contraction portion of another embodiment for a different reference would render the entire process inoperative without significantly changing or reworking the existing portions.

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At least for these reasons, Chang '325 and Chang '974 considered separately or in combination do not disclose, teach, or suggest all of the features of Applicant's invention as claimed in claims 1 and 17. Claims 2-6 and 8-16 and claims 18-21 would be allowable at least by virtue of their dependence on claims 1 and 17 respectively.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned attorney at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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PATENT TRADEMARK OFFICE

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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 7 is canceled without prejudice or disclaimer.

The claims are amended as follows:

1. (Amend) A liquid jetting apparatus, comprising:
 - a liquid jetting head, including a nozzle orifice, a pressure chamber communicated with the nozzle orifice, and a pressure generating element which varies the volume of the pressure chamber; and
 - a drive signal generator, which generates a drive signal including a drive pulse supplied to the pressure generating element, the drive pulse including:
 - a first expanding element, which drives the pressure generating element so as to expand the pressure chamber, so that a meniscus of liquid in the nozzle orifice is pulled toward the pressure chamber, the first expanding element being supplied for a time period which is not greater than a half a natural vibration period of the pressure chamber;
 - a first contracting element, which drives the pressure generating element so as to contract the pressure chamber expanded by the first expanding element, so that a center portion of the meniscus is swelled in an ejecting direction of a liquid drop, a potential difference of the first contracting element being not greater than 60% of a potential difference between a minimum potential and a maximum potential of the drive signal;
 - and

a second expanding element, which drives the pressure generating element so as to expand the pressure chamber contracted by the first contracting element, so that a marginal portion of the swelled center portion of the meniscus is pulled toward the pressure chamber,

wherein the drive pulse includes a contracted state holding element, which connects the first contracting element and the second expanding element such that a termination end of the first contracting element and a start end of the second expanding element have an identical potential; and

wherein the contracted state holding element is supplied for a time period which is not greater than one quarter the natural vibration period of the pressure chamber.

17. (Amended) A method of driving a liquid jetting apparatus provided with a liquid jetting head which includes a nozzle orifice, a pressure chamber communicated with the nozzle orifice, and a pressure generating element, the method comprising the steps of:

a first expanding step, for driving the pressure generating element so as to expand the pressure chamber, so that a meniscus of liquid in the nozzle orifice is pulled toward the pressure chamber as much as possible;

a first contracting step, for driving the pressure generating element so as to contract the pressure chamber expanded by the first expanding step, so that a center portion of the meniscus is swelled in an ejecting direction of a liquid drop;

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a second expanding step, for driving the pressure generating element so as to expand the pressure chamber contracted by the first contracting step, so that a marginal portion of the swelled center portion of the meniscus is pulled toward the pressure chamber; and

a second contracting step, for driving the pressure generating element so as to contract the pressure chamber expanded by the second expanding step, so that the meniscus is again urged in the ejecting direction to increase jetting speed of a satellite liquid drop which follows a main liquid drop,

wherein a contracted amount of the pressure chamber in the second contracting step is larger than at least one of a contracted amount of the pressure chamber in the first contracting step and an expanded amount of the pressure chamber in the second expanding step; and

wherein the contracted amount of the pressure chamber in the second contracting step is not larger than an expanded amount of the pressure chamber in the first expanding step.

Claims 22-26 are added as new claims.